

# Foot-and-Mouth Disease Vaccine

## Foot-and-Mouth Disease

Foot-and-mouth disease (FMD) is a severe, highly infectious viral disease of cloven-hooved animals. Although not usually fatal, it causes suffering and vastly reduces animals' commercial value by reducing their weight and milk output. Cattle, swine, sheep, goats, and deer are highly susceptible and can exhibit signs of infection after an incubation period of only 1 to 5 days; however, in sheep and goats it may go undetected altogether. Clinical signs include fever and blister-like lesions followed by erosions on the tongue and lips; in the mouth, muzzle, and snout; on the teats; and between the hooves.

FMD is widely believed to be the most economically devastating livestock disease in the world. If it were introduced into the United States, which is FMD-free, it could cause billions of dollars in losses to the U.S. economy. Although the disease is not a risk to humans, people who have worked around or been near infected animals could carry and spread the virus via their cars, clothing, shoes, and, potentially, through their respiratory tracts.

## The FMD Vaccine

Vaccines are used to produce or stimulate protective immunity against a particular disease. FMD vaccines are killed virus preparations that are pure, safe, and effective. They are available to the United States through the North American FMD Vaccine Bank. Mexico and Canada are also members of the Bank.

There are seven different types and more than 60 subtypes of FMD virus. Vaccines for FMD must match the type and subtype present in the affected area and there is no universal vaccine against the disease. FMD vaccine is produced by first growing the virus in cell cultures; clarifying the virus harvest to remove debris; and inactivating it using a chemical such as binary ethyleneimine. The North American FMD Vaccine Bank stores different types of concentrated, inactivated FMD virus antigen at ultralow temperatures over liquid nitrogen. In this state, several types of antigens can be kept indefinitely and formulated into vaccine rapidly should an FMD outbreak occur. In addition, the Bank maintains master seeds for production of large amounts of finished product.

Animals that receive the vaccine usually develop some degree of protection against clinical signs of FMD within 7 to 8 days.

## The North American FMD Vaccine Bank

The North American FMD Vaccine Bank is housed at the Department of Agriculture's (USDA) Foreign Animal Disease Diagnostic Laboratory (FADDL) at Plum Island Animal Disease Center. The Center, located 1.5 miles off the coast of Long Island, NY, is the only place in the United States where scientists can conduct research and diagnostic work on highly contagious exotic animal diseases such as FMD. Currently, the facilities on Plum Island operate at a biosafety-3 level. This designation means the facilities are designed, constructed, and operated to prevent the escape of microorganisms from the laboratory into the environment.

Scientists at FADDL monitor FMD outbreaks around the world and stock the Bank with master seeds for the most active serotypes or strains of the virus. If necessary, these scientists can isolate and identify new seeds from a field sample in as little as 4 days. With this information, FADDL scientists would know what vaccine type to order from the vaccine bank, and if new master seeds for emerging new FMD subtypes could be prepared as needed. FADDL scientists constantly monitor the quality of the vaccine concentrates available at the vaccine bank. Their testing has helped to ensure that FMD vaccines are not contaminated with other microorganisms and that they do not produce adverse local or systemic reactions following administration.

## Reasons to Vaccinate

Emergency vaccination can play an important supporting role in the control of FMD outbreaks in FMD-free countries such as the United States. Vaccination can help contain the disease quickly if it is used strategically to create barriers between infected zones and disease-free zones.

If USDA officials were to determine that FMD vaccinations should be administered to U.S. livestock in response to an FMD outbreak, USDA officials would collaborate with State and local officials to determine vaccination zones, and they would work together to inform livestock producers and the general public of the necessary quarantines and vaccination procedures.

## Reasons Not to Vaccinate

Although FMD vaccines are available, there are several reasons why a preventive vaccination program has not been implemented here. The United States has been free of the disease since 1929. Strict import restrictions are in place to provide the first line of defense. USDA's Animal and Plant Health Inspection Service (APHIS) imposes import prohibitions on live ruminants and swine and their products on all FMD-affected countries.

In a country where FMD has not been detected, a vaccine program is costly and ineffective. The immunity period is 6 to 12 months, requiring annual re-vaccination. With so many subtypes of FMD virus in circulation around the world, it would be difficult and extremely costly to provide a wide spectrum of vaccination in the United States. This could be expensive and would require much time and effort from animal health technicians, producers, veterinarians, and others in the livestock industry.

The vaccine does not protect animals against FMD infection; it only protects animals from developing the clinical symptoms of the disease. This means that if a vaccinated animal encountered the disease in circulation, the animal could harbor the virus for several months or years in its upper respiratory tract. Vaccine teams could also carry the virus from an infected farm to a clean farm if they do not follow proper sanitary procedures.

If the United States implemented an FMD vaccination program, the country would lose its FMD-free status. Exporters of U.S. livestock would face many new restrictions. This could cost U.S. livestock producers millions, if not billions, of dollars. The Office International des Epizooties' current International Animal Health Code requires FMD-free countries such as the United States to undergo a 3-month waiting period between the time they have slaughtered their last vaccinated animals and the time they can claim FMD-free status, assuming ongoing surveillance and serological testing have demonstrated the country's freedom from FMD viral activity. If vast numbers of animals were to be vaccinated or if re-vaccinations were needed, the United States could wait years before regaining FMD-free status.

## Summary

USDA currently maintains a variety of FMD vaccines, which could be swiftly finished and deployed if officials determined this to be an appropriate response to an FMD outbreak. Drawbacks to using the vaccine include its potentially devastating impact on export markets, so USDA's first response to an outbreak would be one of "stamping out"—freezing animal movement and eradicating the disease immediately.

USDA scientists at Plum Island Animal Disease Center continue to develop and experiment with novel biotechnology to improve FMD vaccines.

## Additional Information

For more information about the FMD vaccine, contact:

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